coopra
ADVANCED HEATING TECHNOLOGIES

EN

Installation Manual

Heating Boiler . . . Type 40C

Wall hung, fan flue, room sealed gas boiler

2007 E000129032

CONTENTS

CHAPTER 1.

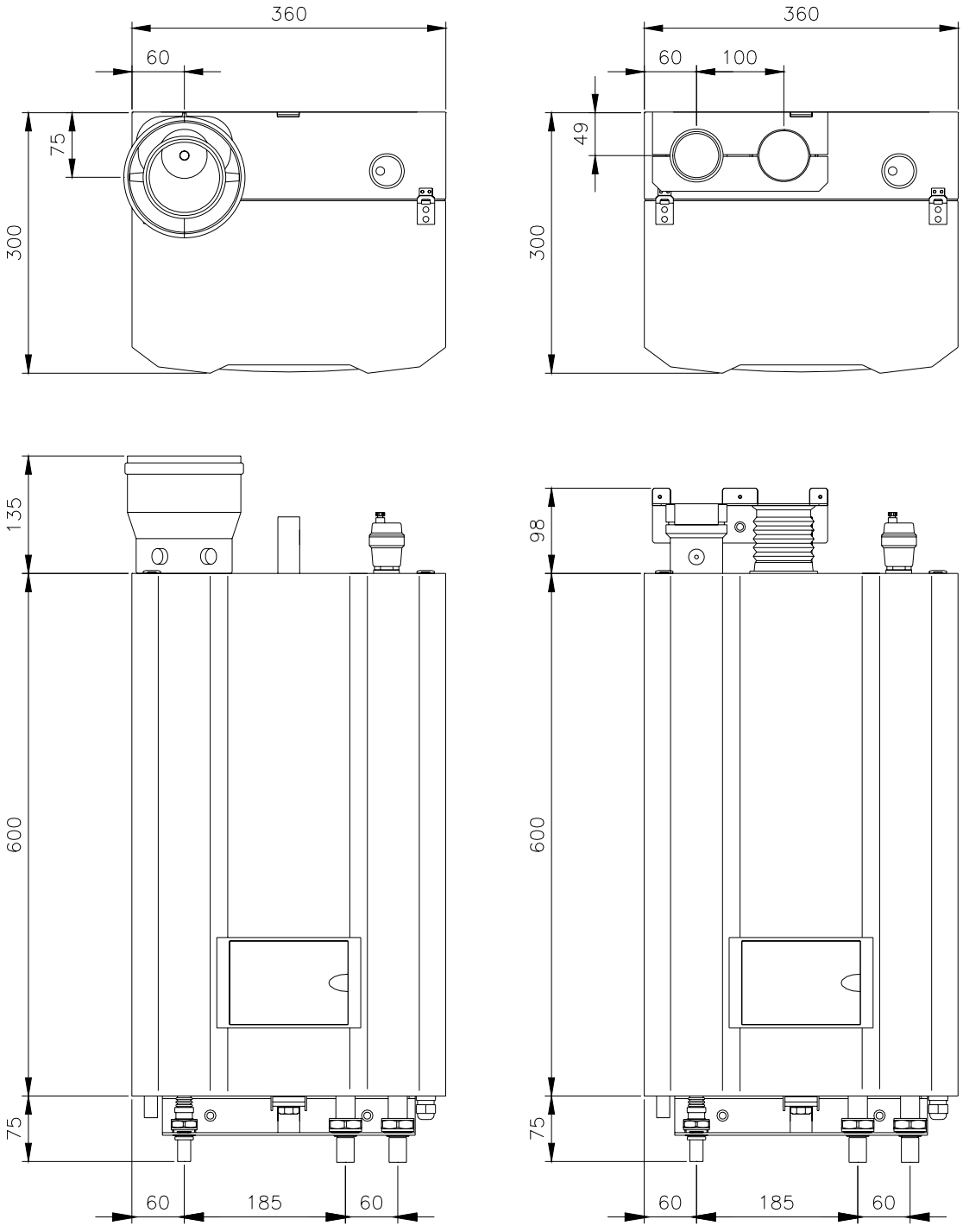
1.1. Technical data

Boiler type		**40C**		
Gas type		**natural gas G20**		**LPG gas G30/G31**
Electrical data	Mains voltage / Frequency	230 V / 50 Hz		
	Power consumption (max.)	144 W		
	Thermostat voltage	24 V		
Dimensions and weight	Height	600 mm		
	Width	360 mm		
	Depth	300 mm		
	Weight	35 kg		
Emission value	CO_2	8.2% - 8.8%		9.2% - 9.8%
	CO (0% 0_2)	12 – 100 ppm		
	NO_X (0% O_2)	10 – 30 ppm		
Flue gas-temperature	at 80/60ºC	< 70ºC		
	at 50/30ºC	< 35ºC		
Maximum chimney resistance	Air feed and flue tube together	125 Pa		
Connections	Gas	Ø 15 mm		
	CH (flow and return)	Ø 20 mm		
	Overflow	Ø 15 mm		
Air feed and flue tube system	Eccentric	Ø 60 – Ø 60 mm or Ø 80 – Ø 80 mm		
	Concentric	Ø 60 / 100 mm or Ø 80 / 125 mm		
Boiler heat exchanger	Water contents	0.8 L		
	Max. temperature	90°C		
	Max. Water pressure	3 bar		
Sound level	Pump high	40 dB(A)		
	Pump low	30 dB(A)		
Certification	CE Identification number	CE0063-AT3070		

Boiler type		**40C**		
Gas type		**natural gas G20**		**LPG gas G30/G31**
Gas technical data type 40	Nominal gas pressure	20 mbar		37/50 mbar
	Heat input CH (gross)	8.1 – 41.1 kW		
	Heat input CH (net)	7.3 – 37.0 kW		
	Nominal output CH at 80/60ºC	7.2 – 36.0 kW		
	Nominal output CH at 50/30ºC	7.9 – 37.9 kW		
	Efficiency at 80/60ºC (net)	Low load = 98.1 %; High load = 97.2 %		
	Efficiency at 50/30ºC (net)	Low load = 108.4 %; High load = 104.2 %		

1.2. Dimensional sketch

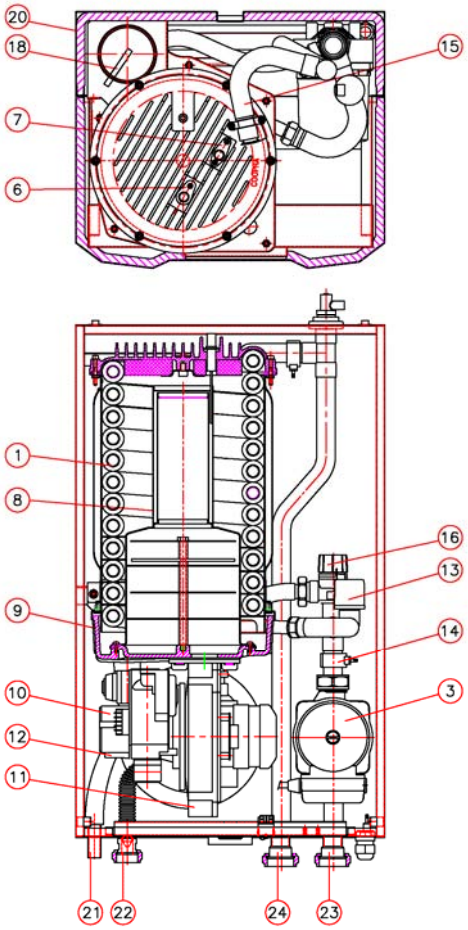
Dimensions in mm



Free space

There must be sufficient space at the top and bottom to be able to suspend the unit and to be able to connect all feed and drain pipes. Normally, roughly 300 mm is required.
It is recommended to leave a free space of 150 mm on the left (for servicing reasons) and 50 mm on the right of the unit.
The front of the unit must be easily accessible for servicing at all times.

1.3. Unit components

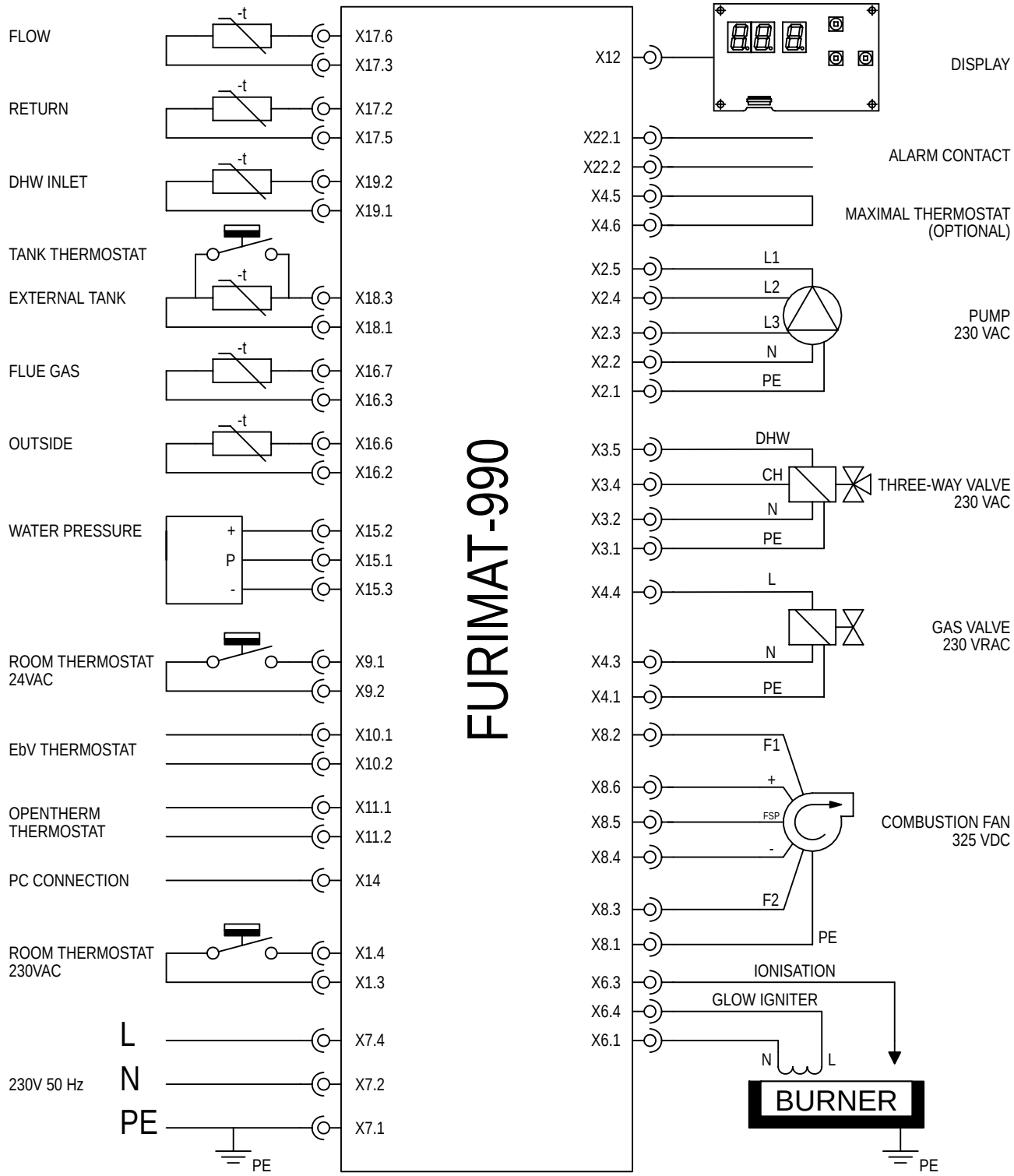


35C / 40C

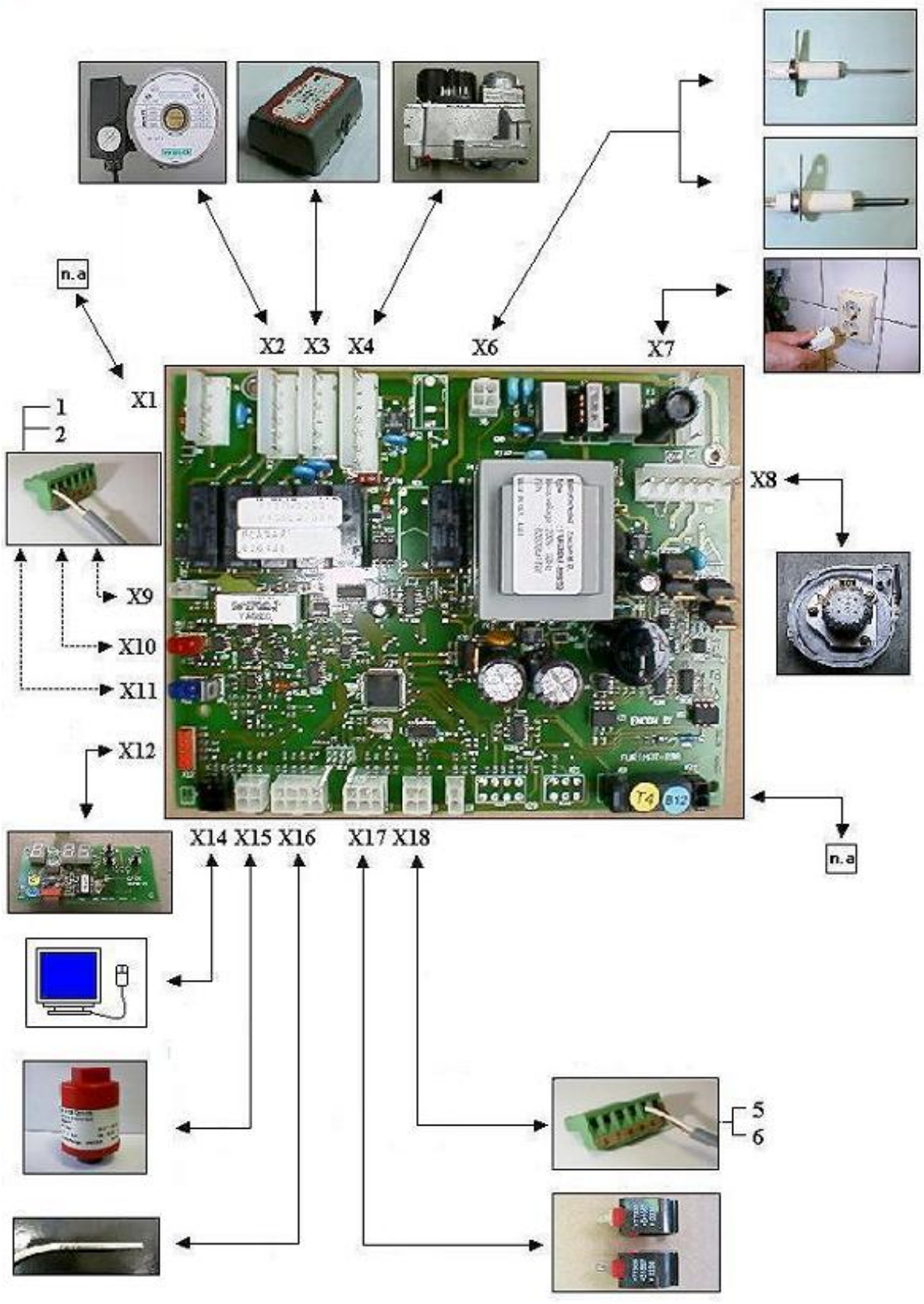
No	Description	Manufacturer
1	Primary heat exchanger	Coopra
2		
3	Pump	Wilo
4		
5		
6	Glow plug	Saint Gobain
7	Ionisation probe	Sapco
8	Burner type 30 / 40	Furigas
9	Vapour tray	Coopra
10	Gas valve	Honeywell
11	Fan	Vibo
12	Venturi type 40	Honeywell
13	Water pressure sensor	Huba
14	Return sensor	Honeywell
15	Flow sensor	Honeywell
16	Safety device 3 bar Model 2000	Emmeti
18	N/A	N/A
19	Flue gas temperature sensor	Tasseron
20	Type plate	Coopra
21	Condensation water overflow	Coopra
22	Gas connection	Coopra
23	Central heating return	
24	Central heating flow	

1.4. Diagrams

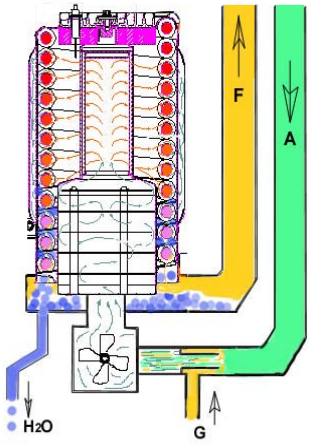
1.4.1. Functional flow diagram



1.4.2. Wiring diagram



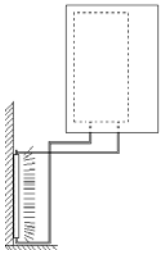
1.5. Operation



A fan sucks the air required for the combustion through the air feed canal (A). Because the combustion air in the venturi sucks an under pressure, the correct amount of gas (G) is automatically added to the combustion air.
The flammable gas/air mixture thus obtained is fed to the burner, via a mixing chamber, to be ignited at the surface of the burner by a ceramic glow plug. The hot combustion gases are efficiently fed through the heat exchanger, where they give their heat to the water. The flue gases are fed outside, through the flue tube (F), into a flue tube exhaust canal.
The condensation water (H_2O) thus obtained is discharged into the sewer.

1.6. Boiler types

Coopra 40C



High efficiency boiler for central heating only.

The Coopra boiler is a heating unit with compact dimensions and a very high efficiency, with versions for domestic and small commercial use for central heating.
The type plate, which specifies the type of gas etc. to be used, for which the unit is set, is on the left side of the unit.
The unit is fixed to the wall with the aid of a separately delivered assembly bracket or rear cabinet.

1.6.1. Burner assy

1.6.2. Primair heat exchanger

1.6.3. Venturi

1.6.4. Pump

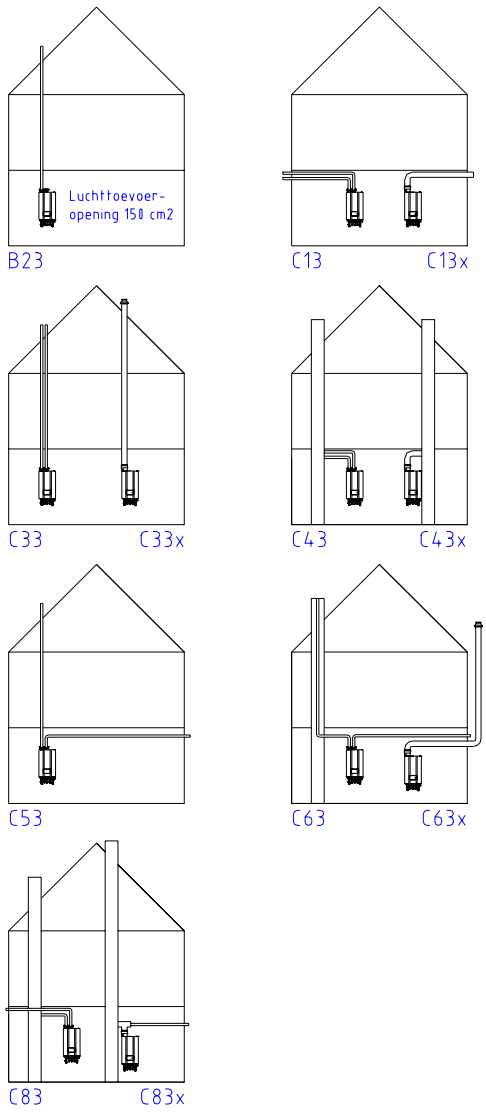
1.7. Conditions of delivery

Coopra Advanced Heating Technologies b.v. supplies its products according to the general conditions of delivery for the metal and electro technical industry. Registered with the Clerk of the District Court at Den Haag on 19 October 1998 under no. 119/1998.

1.8. Configuration of flue tube and air supply

See figure below for an overview of possible configurations.
The units are approved for application on the drain systems:
B23, C13(x), C33(x), C43(x), C53, C63(x), C83(x).

Preferably use flue tube materials, roof ducts and exterior wall ducts with a quality mark.
With plastic drain materials, use a unit with a flue gas temperature sensor.



1.9. Environmental conditions

The area in which the unit is installed must satisfy the applicable regulations.
The wall must be able to bear the weight of the unit (loaded weight approx. 40 kg).
If you use a different assembly surface than a bricky wall of sufficient thickness, you must select suitable fixtures yourself and properly install the unit.
The unit may not be fitted in a chemically aggressive environment.
The unit with air feed and flue gas exhaust satisfies the requirements of protection class IP44 and may therefore be installed in a wet area.
Although the unit is fitted with an internal frost protection, it may not be exposed to extremely low ambient temperatures (lower than -10°C).

1.10. Permitted flue resistance

Indication for the resistance values given in table below apply to

- **Flue exhaust flow rate of 61 m^3/hour** (at 70 'C)
- **Supply air flow rate of 48 m^3/hour** (at 20 'C)

The total resistance of the flue tube and air supply together may not be greater than 85 Pa.

	Ø 100 mm	**Ø 80 mm**
Type 40 (35)		
Tube per metre	2,5 Pa	5.0 Pa
Bend 90°, R = 1.5 D	3.0 Pa	6.0 Pa
Bend 90°, R = 0.5 D	5.0 Pa	10.0 Pa
Bend 45°, R = 1.5 D	2.0 Pa	4.0 Pa
Bend 45°, R = 0.5 D	3.5 Pa	7.0 Pa
Roof duct	20.0 Pa	30.0 Pa

1.11. Heating of central heating water

If the room thermostat or space unit indicates that heat is required for the central heating, the unit will heat the central heating water as necessary. The power supplied is automatically adapted to the heat required and is also continuously variably adapted to the heat demand with the use of an on/off thermostat.
When the thermostat indicates that the desired temperature has been reached, the central heating water is no longer heated. The central heating pump will continue to run for a previously set time to distribute the heat evenly over the heating installation.

A differential bypass valve must be installed on plants where it may happen that various radiators are simultaneously excluded from the circuit because of closure of control or zone valves.
The by-pass valve must be mounted in the installation between the flow and the return, provided that flow direction indicated by arrow is respected.
To adjust the by-pass valve rotate knob of the graduated scale on setting 2.5-3.0. This value corresponds to the meters of pump head (m H2O).
Lock the screw on the groove knob.

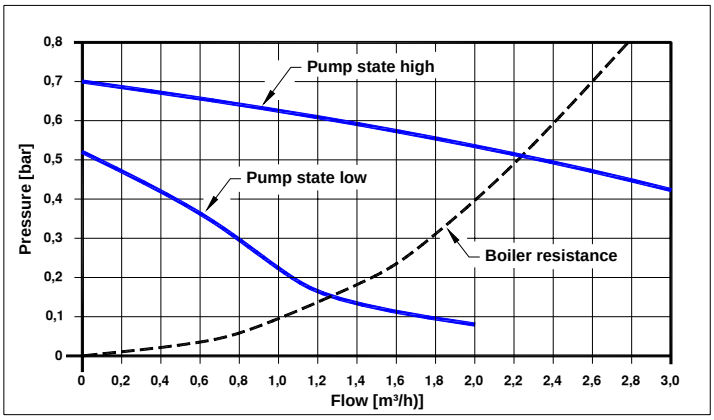
1.12. Pump and hydraulic resistance

The pump characteristic and the resistance graph of the unit are given below.

If set on automatic function (menu setting) the electronics switches the speed of the pump to “high” or “low”, depending on the temperature demand:

- Dt > 30 °C : the pump runs „high speed“.
- Dt < 10 °C : the pump runs „low speed“.

Dt = Setpoint temperature deducted with the actual Flow temperature.



1.14. Standards / Guidelines

With the installation of the unit, all local regulations must be followed, where applicable, including the provisions of the following standards and guidelines:

- Building Regulations
- Regulations for natural gas installations
- Regulations for LPG (if applicable)
- Guidelines for existing gas installations
- Safety requirements for central heating installations
- Safety provisions for low voltage installations
- General regulations for drinking water installations
- Water authority regulations
- Ventilation in dwellings
- Supply of combustion air and exhaust
- House sewerage in homes and dwellings
- Fire Brigade regulations
- Factory Act regulations
- Regulations applicable to HWS water Ask for the locally applicable regulations at the local water company as they are different in some areas

1.15. General safety regulations

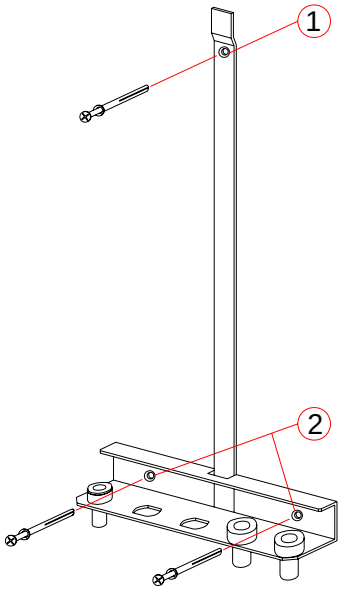
The installation may only be performed by a recognised installer.
Take note that internal parts of the unit can carry a dangerous electrical voltage (230 Volt).
Take note that the unit, the various pipes and the flue gas exhausted by the unit can reach high temperatures (up to 90°C).
Before carrying out maintenance activities in or on the unit, you must close the gas tap, switch off the electricity supply and pull the mains plug out of the socket.

1.16. Water quality

The composition and quality of the system water has a direct effect on the performance of the total system and the life of the boiler heat exchanger. Great care must be used with the addition and use of chemicals, water softeners, oxygen binders, de-aerators, aerators and water filters as they increase the chance of malfunctions.
Corrosive elements of certain additives can attack the system and cause leakages; the build-up of undesired deposits generally leads to fatal damage of the heat exchanger.

CHAPTER 2. INSTALLATION

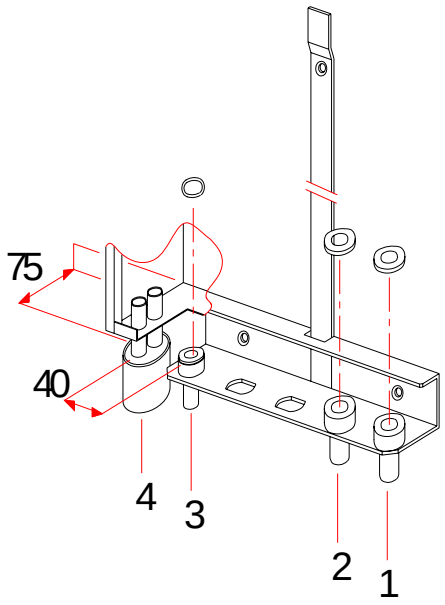
2.2. Mounting the assembly bracket



To mount the assembly bracket on a brick wall of sufficient thickness, use the screw plugs that are supplied. When you have determined the place of assembly, proceed as follows:

1. Draw the position of the hole (1) in the strap of the assembly bracket.
2. Use a masonry drill of 8 mm diameter to drill a hole with a sufficient depth in the wall.
3. Keep the hole (1) in the assembly bracket in front of the hole in the wall and fit one of the screws supplied through the assembly bracket in the hole.
4. Align the assembly bracket with the aid of a spirit level.
5. Use a masonry drill of 8 mm diameter to drill holes with a sufficient depth in the wall through the two bottom holes (2) in the assembly bracket.
6. Fit two of the screws supplied in the bottom holes.
7. When using assembly brackets with ac lamping plate for eccentric flue tube and air feed connection:
   - Use a masonry drill of 8 mm diameter to drill a hole with a sufficient depth in the wall through the hole in the clamping plate and fit a nail plug in this hole.
   - Fit the clamping plate at right angles.
8. Fix the assembly bracket firmly by tightening all screws.

2.3. Water and gas connections



1 = Heating return pipe connection
2 = Heating flow pipe connection
3 = Gas connection
4 = Draconin connection

2.3.1. Gas connection

- Connect the gas pipe to connection (3).
- Install the gas pipe stress free.
- Include an approved stopcock in the pipe.
- Carefully blow the gas pipe clean.

2.3.2. Central heating water connections

- Connect the central heating return pipe to connection (1). The central heating return pipe (1) must be fitted with a suitable expansion vessel. The size of the expansion vessel must be determined on the basis of the central heating water temperature and the total water content the installation contains.
- Connect the central heating flow pipe to connection (2).
- A differential bypass valve must be installed on plants where it may happen that various radiators are simultaneously excluded from the circuit because of closure of control or zone valves.
- Install a filling and draining device in the central heating system. Do not use the overflow valve as a drain. The overflow valve is a safety valve that ensures that the system is not subjected to a too high pressure (max 3.0 bar).
- Stopcocks must be fitted in the central heating flow pipe (2) and the central heating return pipe (1).
- If it may be expected that the central heating water will be severely contaminated by under floor heating, fitting is a 2 kg dirt filter in the return pipe is recommended. Coopra cannot give a guarantee for damage to the unit that is caused by dirt in the system.
- Before connecting the boiler unit, rinse the system completely to remove all contamination.

2.4. Seal on the waterside

With the use of the group of taps, you can now make a check on the seal on the waterside of the system.

2.5. Draconin connection

There must be a connection for the removal of the condensation water to the drain. This connection must be fitted with a trap to prevent smell problems.
A tundish connection must be made because of possible overpressure or underpressure in the drain.
Fit the condensation drain pipe (4 (inner diameter 40 mm minimum) several centimetres left of the gas pipe.

2.6. Electricity connection

There must be an electrical outlet with earth connection available at a maximum distance of 1 m from the unit.

The electricity connection (230 VAC) must consist of live, neutral and earth
A good earth connection is a requirement for good operation of the unit.

CHAPTER 3. SUSPENDING THE UNIT

3.1. The unit

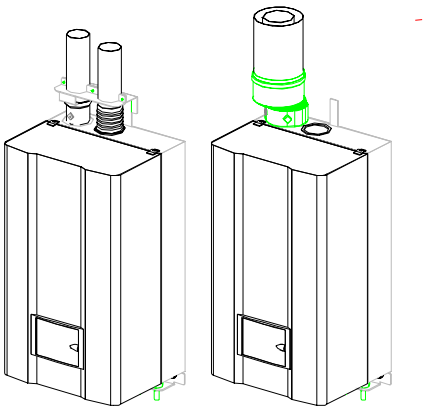
Before unpacking the unit, check whether the type of gas to be used corresponds with the specification on the packing. If you have any questions, contact your supplier.
To prevent back injury, take account of the fact that the weight of the unit is roughly 35 kg.

3.2. Suspension

Place an O-ring in the middle of each of the connections present (1) - (5).
Remove the caps from the pipes of the unit.
Keep the unit straight against the wall at about 5 cm above the site of the mounted assembly bracket or the assembly cabinet.
Press the unit into the guide and let it drop carefully, so that the hook on the suspension bracket falls into the opening at the rear of the unit and the pins at the bottom of the unit fall in the corresponding openings in the suspension bracket. Here, the connection pipes of the unit fall over the connection points of the suspension bracket.
Firmly tighten the union nuts of each of the connections present (1) to (5) with the aid of a spanner.

3.3. Fitting the flue tube and air supply

3.3.1.



Connecting the eccentric flue and air supply (2-pipe system)
When the flue tube and air supply are connected eccentrically, proceed as follows:
1. Fit the flue tube in the opening, in the suspension bracket.
2. Let the pipe protrude 30 -35 mm under the clamping plate. Slide the sliding piece (1) upwards over the flue tube.
3. Fit the air supply in the opening in the suspension bracket.
4. Let the pipe protrude 40 - 45 mm under the clamping plate.
5. Fit the rubber bellows over the air supply pipe and seal them with the hose clip.
6. Fit the clamping plate on the suspension bracket and tighten it with the three screws supplied. Take care here that the clamping plate falls in the groove of the sliding piece.

3.3.2. Connecting the concentric flue tube and air supply (80/125 mm adapter)
When the flue tube and air supply are connected concentrically, proceed as follows:
1. Fit the 80/125 mm adapter on the unit before you place the unit.
2. After you have placed the unit, fit the concentric pipes on the 80/125 mm adapter.

3.3.3. Connecting the concentric flue tube and air supply (60/100 mm adapter)
When the flue tube and air supply are connected concentrically, proceed as follows:
1. Fit the 60/100 mm adapter on the unit before you place the unit.
2. After you have placed the unit, fit the concentric pipes on the 60/100 mm adapter.

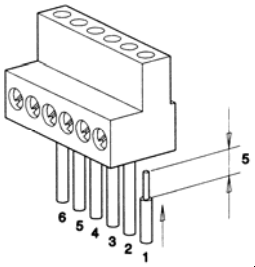
3.4. Condensation water drain/overpressure protection on drain

Make a tundish between the condensation water drain/overpressure protection of the unit and the drainpipe.

3.5. Connection block

The connections of the green connection block are all volt-free contacts. Therefore, do not connect 230 Volts to them!

If no on/off room or modulating room thermostat is used at all, terminals (1) and (2) must be connected by wire.



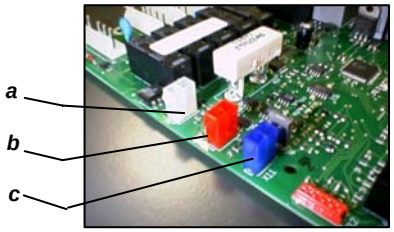
terminals (1) - (2)	Connection for 24 Volt thermostat
terminals (3) - (4)	Connection for 12 kOhm external temperature sensor
terminals (5) - (6)	

3.5.1. On/off room thermostat (if applicable). Connect to terminals (1) and (2)
The on/off room thermostat (24 V) must be fitted in the same building as the unit.
Strip about 5 mm off the insulation of the wires of the room thermostat. Stick the stripped ends of the wires into connections (1) and (2) of the connection block. Make sure that the wires do not make a short circuit. Firmly tighten the screws in the connection block.

3.5.2. Modulating room thermostat (if applicable). Connect to terminals (1) and (2)

The modulating room thermostat must be fitted in the same building as the unit.
Strip about 5 mm off the insulation of the wires of the room thermostat. Stick the stripped ends of the wires into connections (1) and (2) of the connection block. Make sure that the wires do not make a short circuit. Firmly tighten the screws in the connection block.

When using a modulating thermostat, the plug on the printed circuit board must be connected with the correct polarity. To reach the printed circuit board, the black casing must be opened. Connect the plug for the relevant modulating space unit to terminal a, b or c, according to the following photograph.



a	White	Connection for an on/off room thermostat	24 Volt
b	Red	Connection for RS30 with Coopra protocol	EBV space regulation
c	Blue	Opentherm connection	Honeywell or TEM space regulation

3.5.3. Connection for the external temperature sensor (if applicable).
Connect to terminals (3) and (4)

If an external sensor is connected, this temperature sensor must be an NTC with a resistance of 12 kOhm at 25°C.

Strip about 5 mm off the insulation of the wires of the sensor. Stick the stripped ends of the wires into connections (3) and (4) of the connection block, see figure 8. Make sure that the wires do not make a short circuit. Firmly tighten the screws in the connection block.
If an external sensor is not used, terminals (3) en (4) can remain open.

3.6. Assembling the connection block

Connect the green connection block in the green socket.

3.7. Placing the jacket

Place the jacket in the appropriate hooks at the top of the unit. Let the jacket pivot until it falls over the unit. Tighten the fastener at the bottom of the jacket.

CHAPTER 4. COMMISSIONING

4.1. Electrical connection 230 VAC

- If the boiler is provided with a **supply cord and a plug** the appliance must be positioned so that the plug is accessible.
- If the boiler is not provided with a **supply cord without a plug** the supply must have a contact separation of at least 3 mm in all poles.

If the supply cord is damaged, it must be replaced by the service agent or similarly person in order to avoid a hazard.

4.2. Main switch

To power up the appliance please switch the main switch on.

If the display of the unit gives the status code 'U' (alternately with an arbitrary other code), this means the live and neutral connections are reversed. Isolate the supply and reverse the connections.

4.3. Filling

During filling with water, the unit must be connected to the mains and be switched on. Fully open all radiator taps.
Connect the water supply to the filling connection. If the unit is not yet filled with water, the display shows a flashing 'P'. The two numbers on the display give the water pressure.
Open the tap to fill the system with water.
When the water pressure is sufficient (> 1.3 bar), the flashing 'P' disappears from the display.
Close, after filling, the filling tap again.

4.4. Reading the water pressure

It is possible to read the water pressure directly from the display. To do this, press the + button of the display for a minimum of 5 seconds.

The unit switches out of the menu back to normal operation:

- automatically after about 5 minutes;
- or if you press the - button of the display shortly.

4.5. Venting

After filling, the heating installation must be vented.

Proceed as follows:
Follow the instructions from the manufacturer/installer for the venting of possible other elements of the heating installation, such as underfloor heating.
Fully open all radiator taps.
Open the air bleed cocks of the radiators one at a time. Use an air bleed key for this.
As soon as water comes out of the air bleed cock, shut the cock off again.

4.6. Chimney sweeper function

The chimney sweeper function has priority over the central heating and HWS regulation.

The chimney sweeper function is activated by simultaneously pressing the "+ and the – buttons" of the display in for longer than 5 seconds.

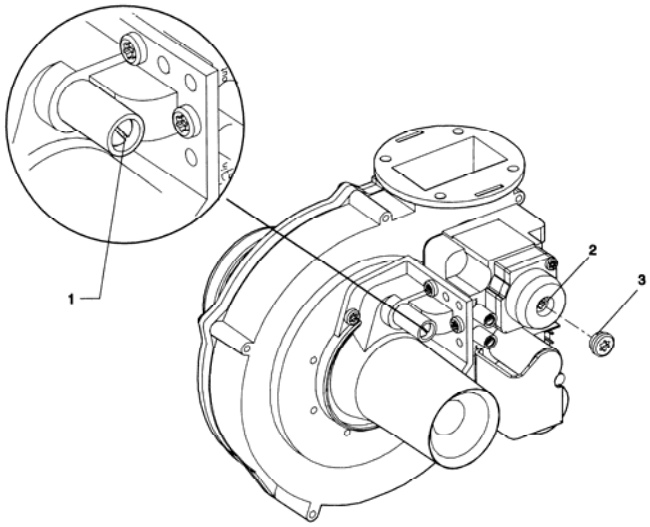
The ionisation current can be read in microamperes in the two right segments.

The capacity that is immediately released is the maximum central heating capacity.

Press the "- button" to go to low load.

Press the "+ button" to switch back to the preset full load capacity.

4.7. Gas / Air Ratio



(1). **Venturi screw** – Full load adjustment
Turn the venturi screw anti-clockwise to increase the CO_2 value, clockwise to decrease it.
(2). **Gas control screw** – Low load adjustment
Turn the screw anti-clockwise to decrease the CO_2 value on low load, clockwise to increase it.
(3). Cover screw

Pre-adjustment to be done in voltage-free condition:

- **LPG GAS – Turn venturi-screw clockwise ↻ completely down on its seat.**
  Then turn the venturi screw anti-clockwise ↺ for 1/2 complete turns.
- **NATURAL GAS – Turn venturi-screw clockwise ↻ completely down on its seat.**
  Then turn the venturi screw anti-clockwise ↺ for 3 complete turns.

PRE- ADJUSTMENT MEASUREMENT:

Distance between Venturi-screw (1) and the Top of the venturi-stud to be about:

- ✓ 12 mm for natural gas G25
- ✓ 14 mm for natural gas G20
- ✓ 16 mm for LPG gas G31

With a vernier callipers the distance between venturi-screw (1) and the Top of the venturi-stud (1) has to be measured to find the rough setting of the venturi screw for full load, and depending of the used gastype.
The exact adjustment of the setting has to be made using the CO_2 analysing method as described below.

4.8. Gas / Air adjustment (CO_2 analysing)

The gas control is set in the factory to the type of gas to be used. This type of gas is stated on the packing and on the identification plate. To check the setting, you have to make a flue gas analysis.

Proceed as follows

Remove the measuring cap from the flue tube.
Fit the measurement probe of a flue gas analyser (CO_2 meter) in the measurement opening of the flue tube canal.
Make sure there is sufficient heat dissipation through the heating.

CO_2 setting	At full central heating load (P=100%)	At low load
Natural gas (G20, G25)	8,8 % CO_2	8,2 % CO_2
Propane (G31)	9,8 % CO_2	9,2% CO_2

4.8.1. Full load

The burner has to burn at maximum central heating capacity (Menu setting P=100%).

Activate the chimney sweeper function on full load.

Read the CO_2 value on the analyser. If the value does not correspond with the value in the "CO_2 setting" table, carefully adjust the venturi screw (1). Turn the venturi screw anti-clockwise to increase the CO_2 value, clockwise to decrease it.

4.8.2. Low load

Activate the chimney sweeper function on low load

Read the CO_2 value on the analyser. If the value does not correspond with the value in the "CO_2 setting" table, carefully adjust the gas control adjusting screw (2). To do this, temporarily remove the cap (3) with the aid of a Torx screwdriver. Turn the screw anti-clockwise to decrease the CO_2 value on low load, clockwise to increase it.

At the end of the flue gas analysis, set the central heating capacity (P) in the menu again to the value that is best suited for the application.

4.9. Placing the jacket

Place the jacket in the appropriate hooks at the top of the unit. Let the jacket pivot until it falls over the unit. Tighten the fastener at the bottom of the jacket.

4.10. Changing over to LPG-gas

First: the venturi adjusting screw fully clockwise until it blocks.

Fit a flue gas analyser (CO_2 meter) in the measurement opening of the flue tube canal.

Full load on LPG

Activate the chimney sweeper function on full load.

Turn the venturi adjusting screw fully clockwise until it blocks.
Unscrew the venturi adjusting screw half a full turn anti-clockwise. Try to start the appliance.
Unscrew the venturi adjusting screw another half a full turn anti-clockwise. Try to start the appliance.
Repeat till the boiler starts.

(A guide for the dimension from the top of the screw to the top of the support is 16 mm).

Read the CO_2 value on the flue gas analyser. If the value does not correspond with the value for propane gas G31 (9,8% CO_2), carefully adjust the venturi screw until the correct value is obtained.

Low load on LPG

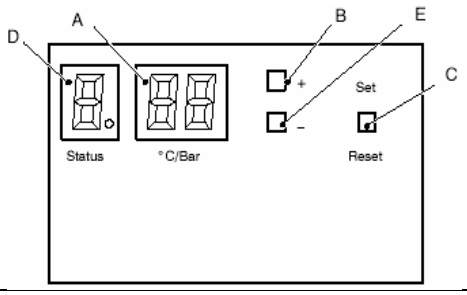
Activate the chimney sweeper function on low load.

If the gas control is already properly adjusted for natural gas, then the low load will not need to be adjusted.

If necessary, adjust the gas regulator screw until the correct value ((9,2% CO_2) is obtained. Note that this setting is critical to adjust.

4.11. Display

A = display
B = + button
C = Set / Reset
D = Status display
E = - button



During operation, the display shows the status of the unit in the form of a code. To be able to read the codes, open the cover in front of the display. The display consists of three 7-segment LED's + three decimal points and three pushbuttons. The left 7-segment LED shows the status or the menu step. The two right 7-segment LED's show the temperature, the pressure or the parameter value.

4.11.1. Normal operation (permanent status indication)
The Normal operation is to indicate the burner action.

- -	Initialisation after restoration of supply power
O	No heat demand, stand-by
C	Central heating heat demand, burner off
C.	Central heating heat demand, burner on
P/C.	Central heating heat demand, low load water pressure
A/C.	Central heating heat demand, low load chimney temperature
c	Central heating pump post-running
b	Burner off / post-running of pump for external HWS cylinder
b.	Burner on
P/b.	Boiler, low load by water pressure
A/b.	Boiler, low load by chimney temperature
O	Frost protection burner off pump running 8C
o.	Frost protection burner on 3C
C (flashing)	Chimney function (temp display max/min/ionisation)

4.11.2. Blocking operation (permanent status indication)
The burner stopped burning due to an incorrect situation. The display gives a permanent indication (not flashing) and the operation can be restored by switching it off and on (volatile block).

U/ code		
	Reversed neutral and line	Power supply line not correctly connected
1	Flow sensor open circuit	Faulty flow sensor Wiring interrupted or not correctly connected
1.	Flow sensor short circuit	Faulty flow sensor Faulty wiring
2	Return sensor open circuit	Faulty return sensor Wiring interrupted or not correctly connected
2.	Return sensor short circuited	Faulty return sensor Faulty wiring
4	Flue gas sensor open circuit	Faulty flue gas sensor Wiring interrupted or not correctly connected
6	Cold water sensor open circuit	n.a.
6.	Cold water sensor short circuited	n.a.
A	Flue gas temperature > 80°C	The burner is reduced to low load
H	Flow sensor > 105°C while the burner was off	Reset the supply power by the on/off switch
E	Internal error	Reset the supply power by the on/off switch
P	Pump test / Start function blocking / Water pressure	Check the central heating system pressure Seized or faulty pump or faulty pump wiring Faulty pressure sensor or wiring
nc	Burner Manager fault	Reset the supply power by the on/off switch

4.11.3. Lock-out (flashing status indication)
In case of lock-out the display gives a flashing indication and the operation can be restored by pressing the reset button, placed on the control panel.

1	Boiler does not pass start temperature test	Check system water flow; second system pump
2	Too many restarts	
3	Internal regulation fault / A/D conversion fault / external sensor fault /Too many restarts	
5	Fan fault	
7	Gas valve fault	
8	Flame detected with closed gas valve	Check gas valve
A	Flue gas temperature > 95°C	Check why flue gas becomes temperature > 95°C
E	Internal interlock fault	Reset the supply power by the on/off switch
H	Flow sensor > 105°C with burner on	Check system water flow
F	Too many ignition attempts	
O	Gas valve connection	Check short cut wire on printed circuit board terminal X4

4.12. Menu structure

By pressing the set/reset button in for longer than 5 seconds, you go to the 'mode' menu.

To change the subsequent "Letter" parameter, the user must press the Set/Reset button.

To change the "Range" setting in the parameter, the user must press the "+" or the "–" button.

Letter	Description	Range	Factory setting	Field of application
C	max. set point of central heating	25°C - 90°C	82°C	
O	Central heating post-running time	1 - 25 min, CO = 24 hours	5 min	
P	Max central heating capacity	33 – 100 %	80 %	
H	Type of application	**0 =** central heating unit **1 =** n.a. **2 =** for external HWS cylinder 12kOhm **3 =** for external HWS cylinder 10kOhm **4 and 5 =** all functions are blocked	unit-dependent	unit-dependent
d				
t				
b	Set point for storage HWS cylinder	40°C -70°C	60°C	external storage vessel
O/b	Basic temperature External characteristic	10 -70°C	20°C	These three settings are only active when an external sensor is connected
O/S	Slope External characteristic	1-100	20	
O/d	Day reference temperature	0°C -70°C	20°C	
r	Factory setting	= Factory setting = Changed factory setting	If you switch back to the factory setting, this has no effect on the H, S and P/S settings	
S	Pump speed	00 = automatic = always high = always low	00 = automatic	
P/S	Maximum pressure jump	= 0.54 = 0.53 = 0.52	= 0.54	

In the View mode, you can read the actual values of:

8 = Water pressure (in bar)

1 = Flow temperature (in °C)

2 = Return temperature (in °C)

3 = Inlet cold water temperature / HWS sensor (in °C)

4 = External temperature (in °C)

5 = External cylinder temperature (in °C)

6 = Flue gas temperature (in °C)

7 = Flame signal (in µA DC)

9 = Last interlock

A = Last blocking

CHAPTER 5. TEMPERATURE REGULATIONS

5.1. CENTRAL HEATING

The permissible central heating flow temperature can be set between 25°C and 90°C. The burner is blocked when the set flow temperature is reached. During the first 60 seconds of a central heating heat demand, the flow temperature may rise to 3°C above the set point before the regulation locks.

5.1.1. Central heating temperature regulation with on/off thermostat without outside temperature sensor

Increasing set point
When the room thermostat is closed (heat demand), the set point (desired central heating flow temperature) rises at a rate of 2°C per minute until the maximum permissible central heating flow temperature is reached (21 minutes from minimum 40°C to 82°C).

Falling set point
When the room thermostat is open (end of heat demand), the set point (desired central heating flow temperature) falls at a rate of 4°C per minute to the minimum central heating temperature (10.5 minutes from 82°C to minimum 40°C).

Burner is on

- when the room thermostat is closed (heat demand)
- and when the actual flow temperature is 5°C below the set point (desired central heating flow temperature)
- and after 3 minutes anti-reciprocital time, if applicable

Burner is off

- when the room thermostat is open (end of heat demand)
- when the actual flow temperature is 3°C above the set point (blocking)
- or when the actual flow temperature is 3°C above the maximum permissible central heating temperature.

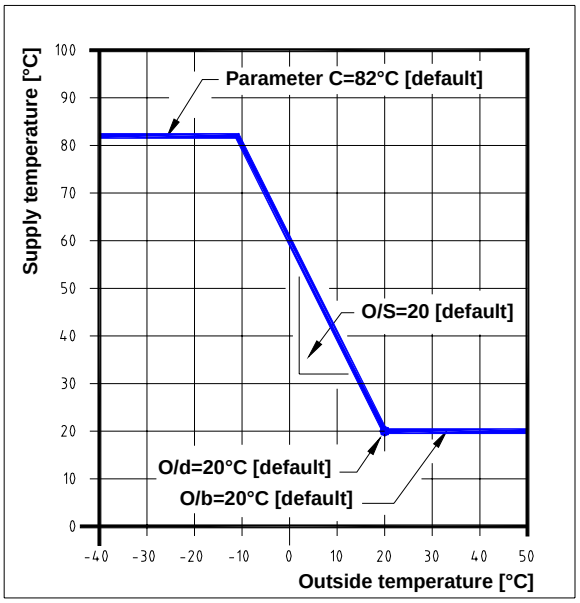
During the set central heating post-running time, the pump will continue to run over the central heating circuit in low load.

5.1.2. Central heating temperature regulation with on/off thermostat with outside temperature sensor

Set point
The desired central heating flow temperature (set point) is calculated on the basis of the measured outside temperature and the [O/S] - [O/d] - [O/b] parameters set in the menu.

Letter in menu	Description	Range	default
O/b	Basic temperature	10 –70 °C	20 °C
O/S	Slope	1 – 100	20
O/d	Flow temperature at outside = 20°C	0 –70 °C	20°C
C	Max. Flowtemp. for central heating	25 –90 °C	82°C

Heating curve



O/b-value: The setting of the minimal Heating flow temperature (value in °C).

O/S-value : The setting for the sloop of the curve.
(change of Flow temperature depending on the change of the outside temperature).

O/d-value : The setting of the flow temperature at an outside temperature of 20°C (value in °C).

Parameter „C“
The setting in the menu „C“ makes the maximal heating flow temperature (default 82°C).

Burner is on

- when the room thermostat is closed (heat demand)
- and when the actual flow temperature is 5°C below the set point (desired central heating flow temperature)
- and after 3 minutes anti-reciprocital time, if applicable, after a reciprocital stop

Burner is off

- when the room thermostat is open (end of heat demand)
- when the actual flow temperature is 3°C above the set point (blocking)
- or when the actual flow temperature is 3°C above the maximum permissible central heating temperature.

During the set central heating post-running time, the pump will continue to run over the central heating circuit in low load.

5.1.3. Central heating temperature regulation with modulating thermostat (Opentherm) with or without outside temperature sensor

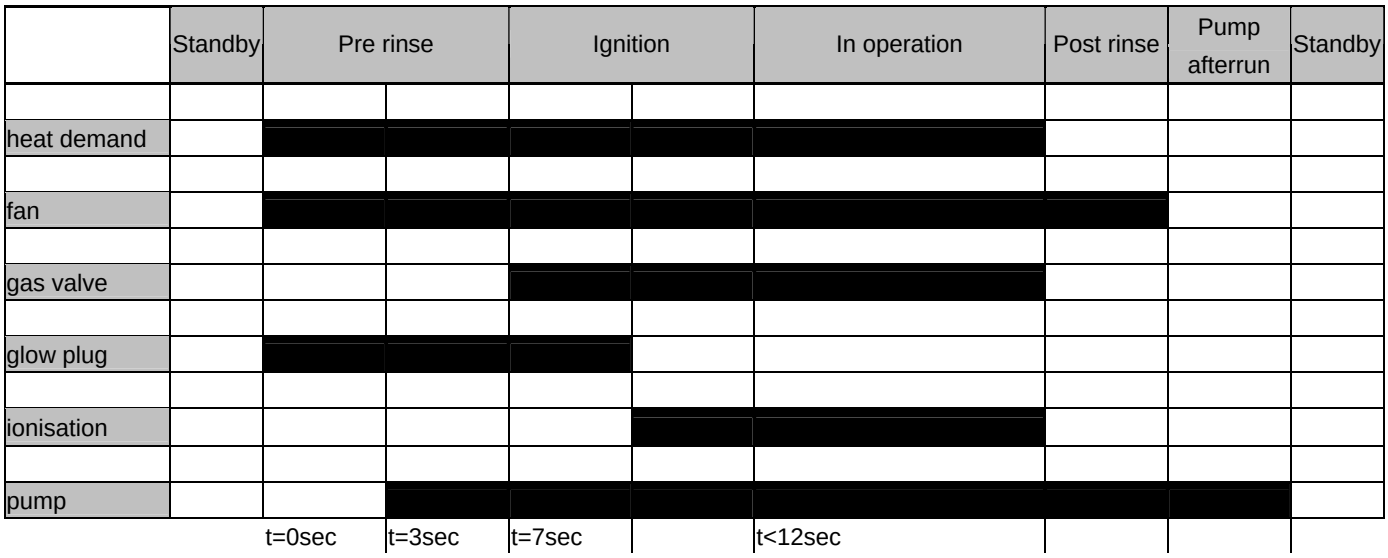
Set point
The set point indicates whether there is a heat demand.
- Without an outside temperature sensor, the desired central heating flow temperature (set point) is calculated by the modulating room thermostat.
- With an outside temperature sensor, the measured outside temperature is sent to the modulating room thermostat, which uses it to calculate the desired central heating flow temperature (set point).

Burner is on
- when the room thermostat is closed (heat demand)
- and when the actual flow temperature is 5°C below the set point (desired central heating flow temperature)
- and after 3 minutes anti-recycling time, if applicable

Burner is off
- when the room thermostat is open (end of heat demand)
- when the actual flow temperature is 3°C above the set point (blocking)
- or when the actual flow temperature is 3°C above the maximum permissible central heating temperature.

During the set central heating post-running time, the pump will continue to run over the central heating circuit in low load.

CHAPTER 6. BURNER STATES and MONITORING



6.1. Standby

Fan off - Gas valve off – Glow plug off - Ionisation off

During the standby, a check is made to see if there is burner demand. If so the boiler will go over to pre rise.

If the glow plug counter is too high (the boiler made too many starts repeatidly) the regulation blocks the burner demand.

Once per hour, if there is no heat demand, the difference between flow and return temperatures must be less than ± 5°C. If this is not the case, the pump will be switched on and a check will be made for a maximum of 10 minutes to see whether the temperature difference goes to within ± 5°C.

The display shows flashing ‘8’.
If a false flame signal is detected during standby for more than 5 seconds, the regulation runs into lock-out with flashing indication ‘8’:

6.2. Pre rinse

Fan on - Gas valve off - Glow plug on - Ionisation off

The difference between flow and return temperatures must be less than 20°C before each burner start.

Pump:
At each new heat demand first the pump is switched off for 3 seconds and the water pressure (static pressure) is measured and stored in the software.
Then second the pump is switched to high speed and the water pressure (active pump pressure) is measured and stored in the software.

If the difference between the active pump pressure and the static pressure is between 0.05 and 0.54 bar a correct water flow throuhg the heat exchanger is present and the ignition time starts.

If the difference is less than 0.05 bar or more than 0.54 bar the regulation locks. The display shows ‘P’. The regulation runs into the “pump test program”.

Fan:
The fan is switched on at the desired purging speed.
After a few seconds, the fan goes from purging speed to the faster ignition speed.

Glow plug:
The glow plug is switched on at the same time as the fan.

The display shows flashing ‘5’.
When the measured fan speed deviates from the desired speed the regulation blocks.
After 60 seconds the regulation runs into lock-out, with flashing indication ‘5’.

6.3. Ignition

Fan on - Gas valve on - Glow plug on/off - Ionisation off/on

The fan is running at the ignition speed. The gas valve is activated. The glow plug ignites the gas / air mixture from the burner. The glow plug will be switched off as soon as an ionisation signal is measured.

If there is no ionisation at the end of the safety time, a new attempt at ignition will be made if this was not the last permitted (third) attempt at starting.

6.4. In operation

Fan on - Gas valve on - Glow plug off - Ionisation on

Temperature test:
To ensure the water flow through the heat exchanger a temperature test is activated.
The difference between flow and return temperatures must be raised by 3°C within 20 seconds after each burner start.

If the difference is less than the previous temperature difference, the burner is started again after 10 seconds.
If this lock occurs more than three times within a heat demand, the regulation locks with ‘1’.

If the difference between flow and return temperatures becomes less than –5°C during burning, the regulation locks.

Fan:
The fan is running at the required speed for modulating heat demand.
When the measured fan speed deviates from the desired speed, post rinse will be performed.

Ionisation:
If the ionisation fails, a restart is made, providing this is not the third time within the burner demand. If this is the third time, the Manager will lock-out.

Pump monitoring:
If the temperature difference between flow and return is greater than 30°C, the pump switches to a high speed. When the temperature difference drops below 10°C again, the pump switches back to a low speed.
If the pump is on for a HWS demand with a Combi-unit or for cylinder heat demand, the pump is continuously at high.

If the system water pressure changes by more than ± 0.1 bar (and ± 0,3 bar with changing pump speed) within 4 seconds, the regulation will block and switch over to the pump test program. This test is defeated for 16 seconds with switching over from central heating to hot water operation and reverse.

6.5. Post-rinse

Fan on - Gas valve off - Glow plug off - Ionisation off

End of heat demand:
At end of heat demand (burner stop) the regulation runs into post-rinse. The fan runs at the last demanded speed.

The display shows flashing ‘5’.
When the measured fan speed deviates from the desired speed the regulation blocks.
After 60 seconds the regulation runs into lock-out, with flashing indication ‘5’.

The display shows flashing ‘8’.
If a false flame signal is detected during post rinse for more than 5 seconds, the regulation runs into lock-out with flashing indication ‘8’:
The operation can only be restored by pressing the reset button, placed on the control panel.

6.6. Lock-out

Fan on/off - Gas valve off - Glow plug off - Ionisation off - Alarm contact on

During lock-out, the pump runs over the central heating circuit.
At the beginning of the lock-out, the fault table in the software is updated.
With some instances of lock-out, the fan will post rinse for 1 minute at 50% of the maximum speed.

6.7. Pump test program

The display shows continious ‘P’.
The pump is switched off for 15 seconds. The system water pressure (static pressure) is measured and stored in the software.
Then the pump is switched to high speed for 15 seconds and 3 seconds after the pump is switched on the water pressure (active pump pressure) is measured and stored in the software.

If the difference is less than 0.05 bar or more than 0.54 bar the regulation locks again.

If the difference between the active pump pressure and the static pressure is between 0.05 and 0.54 bar a correct water flow throuhg the heat exchanger is present. The pump test is finished.

6.8. System pressure monitoring

The boiler is in working mode when the system water pressure is between 0.5 and 3.0 bar.

With a water pressure between 0.2 and 0.5 bar, the burner is limited to low load.

If the water pressure is less than 0.2 bar, the regulation locks with a ‘P’ + ‘pressure’ on the display. The display shows alternately the ‘P’ and the normal status display.
This lock is removed when the water pressure goes above 1.3 bar.

If the water pressure is greater than 3.0 bar, the regulation locks with a ‘P’ + ‘pressure’ on the display. The display shows alternately the ‘P’ and the normal status display.
This lock is automatically removed when the water pressure goes below 3 bar.

6.10. Temperature regulation

Burner is off when the actual flow temperature is 3°C above the set point (desired central heating flow temperature 25°C - 90°C). The block is removed with an actual flow temperature of 5°C below the set point.

If the temperature difference between flow sensor and return sensor is greater than 45°C, the regulation blocks. The block is removed with a difference of less than 20°C.

If the temperature difference between flow and return sensor is less than –5°C, the regulation will lock immediately during central heating and 20 seconds after ignition during tapping.

6.11. Limiter

The display shows continuous ‘H’.
If the flow temperature goes above 105°C, when the burner is off, the regulation will lock with a continuous ‘H’.
Burner action is restored automatically when the actual flow temperature is 5°C below the set point (desired central heating flow temperature 25°C - 90°C).

The display shows flashing ‘H’.
If the flow temperature goes above 105°C, when the burner is on, the regulation will lock-out with a flashing ‘H’.
The lock-out situation can be removed by pushing the reset button manually.

6.12. Flue sensor

Switching the supply voltage on makes the flue sensor active.
If the flue sensor measures a temperature below –25°C, the regulation locks with the message flue sensor interruption (‘4’).

Low load:
If the flue gas temperature goes above 80°C, the burner is limited to low load.
If the flue gas temperature goes below 70°C, the blocking actions will be automatically removed.

The display shows continuous ‘A’:
If the flue gas temperature goes above 90°C, the regulation blocks with continuous ‘A’.
If the flue gas temperature goes below 70°C, the blocking actions will be automatically removed.

The display shows flashing ‘A’:
If the flue gas temperature goes above 95°C, the regulation runs into lock-out with flashing ‘A’.

6.13. Frost protection

If the flow sensor temperature is below 8 °C (and if there is no heat demand) the pump runs into the heating mode and the display shows ‘o’.

If the flow temperature goes below 3 °C, the regulation starts the burner to low load.

When the return sensor temperature is above 15 °C, the frost protection is finished.

When an external sensor is connected and the outside temperature is below –4 °C, the pump runs into the heating mode. This situation is removed at an outside temperature of –2 °C.

6.14. Glow plug protection

The glow plug protection counter is incremented at each ignition. This counter is decremented per minute.
If this counter is too high, to protect the glow plug for overheating by to many start attempts repeatedly, the boiler start is delayed.

CHAPTER 7. MAINTENANCE

High voltage! ! !

The wiring of the pump, the three-way valve, fan and wiring of the gas block can be under a voltage of 230 VAC.

Serial connection


A PC or Laptop can be connected for an extensive diagnosis and display of the functionality. The necessary cable (which contains an electrical isolation) and software can be ordered as options.

7.1. ANNUAL MAINTENANCE

After the first year, have a recognised installer or maintenance man inspect the unit. He can ascertain the maintenance deadline on the basis of the inspection and circumstances. A certified (SCIOS) installer should inspect the unit annually.

7.1.1. Checking the CO_2 percentage on full load

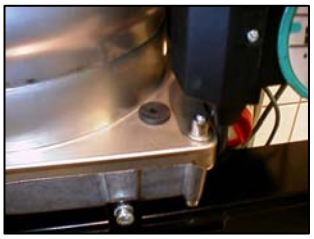
The nominal value for natural gas at full load is 8.8% CO2.

The unit does not need to be cleaned if the measured CO_2 percentage at full load is within 8.8% CO_2 and 9.4% CO_2.

7.1.2. Measuring the load on the unit

A load drop can be the consequence of a clogged flue gas channel or a clogged air intake channel. Check whether this is the case by measuring the load on the unit. First set the central heating capacity "P" to 100% in the menu. Let on the unit burn on chimney sweeper function at full load. Measure the gas consumption. If the ascertained deviation in load is no more than 15% of the nominal value, the flue gases can be sufficiently exhausted and there is no clogging. At the end of the check, reset the central heating capacity "P" in the menu to its customer-specific value.

7.1.3. Checking the condensation water drain



There is an opening for this purpose on the top of the vapour tray. First remove the rubber sealing plug; rinse the vapour tray and drain with clean tap water. When no more impurities are removed, the vapour tray is clean. Also clean the trap.

7.1.4. Ionisation probe

The ionisation probe is a part that wears. An insulating layer can be formed in the flame at high temperature. This layer can be removed with fine sandpaper. Do not clean the ionisation probe with coarse sandpaper, because grooves in the surface of the pin will accelerate the formation of the layer.

Full load:
Correct ionisation current between 6 µA DC to 13 µA DC.
Low load:
Correct ionisation current between 3µA DC to 13 µA DC.

Unplug the plug of the ionisation probe (low voltage). Remove the two screws from the ionisation clamp. Remove the ionisation probe from the cover and check the ionisation probe. The ionisation probe must be straight and clean (a slight deposit is normal), Clean or replace the ionisation probe.

7.1.5. Water pressure

Check the water pressure; top up and de-aerate as necessary.
Press the ‘plus’ button in for at least 5 seconds to see the actual water pressure in bar on the display.
Press briefly on the ‘min’ button to return to operational mode.

CHAPTER 8. MALFUNCTIONS

High voltage!
The wiring of the pump, the three-way valve, fan and wiring of the gas control can be under a voltage of 230 VAC.

8.1. Draining the unit

- On the central heating side: Switch the unit off and open the filling tap.
- On the HWS side: Switch the unit off. Shut the inlet combination off. Open a hot water tap and the protection device of the inlet combination.

When using the group of taps (see the accessory list), it is possible to only tap the unit. Proceed as follows:
- Switch the unit off.
- Close all taps under the unit.
- Close the inlet combination
- Open the filling tap under the unit.
- Open a hot water tap.
- Open the protection device in the unit and of the inlet combination.

8.2. No signal on the display

If there is no signal on the display, check if the mains voltage of 230 VAC is present on the unit.
There must be voltage of 230 V on the live connection "L" and no voltage on the neutral connection "N".
Check whether the on/off switch on the bottom of the unit is switched on.

Check the glass fuse on the printed circuit board Careful, high voltage! The fuse is placed on the printed circuit board in the 230 V circuit. So first disconnect the unit mains!

8.3. Fault code 'U/d or U/O' (alternating U with a status code will appear on the display)

This fault code occurs when the Live and Neutral are exchanged or when no Earth is present.
Reverse the plug so that the Live is connected to Live and Neutral to Neutral.

8.4. Unit does not respond to central heating heat demand

Is the parameter for the type of unit correctly set in the menu?

- **Parameter H = 1** is not active (no heating).
- **Parameter H = 4** is not active (no heating).
- **Parameter H = 5** is not active (no heating).

Check for correct assembly and/or cable fracture of the wiring of the room thermostat (terminals 1 and 2) of the terminal block) and, if applicable, the external sensor (terminals 5 and 6) of the connection to the building management system (terminals 3 and 4).

8.7. Check function of gas control

Open the outlet pressure measurement nipple of the gas control
- connect the pressure meter to the outlet pressure measurement nipple
- measure the pressure (this must be zero)
- start the unit.
- the unit will now be rinsed at 1500 rpm
- next, the fan starts at the initial speed of 3000 rpm.
- the pressure meter will now indicate an underpressure of approximately 3 mbar
- when the gas control is opened, the zero pressure regulator will again make zero pressure.
- if not, then the gas control is not functioning.

8.8. Measuring the fan impedance

Check the resistance of the coil, the two outermost contacts on the fan motor.

The value that the multimeter shows must be between 115 and 120 Ohms at room temperature.

If the fan is defective, the drive on the drive on the Manager may also be damaged.

8.9. Fitting instructions for the pressure sensor

The seal is made with an “0”-ring. The pressure sensor must only be tightened slightly more than hand tight.

8.10. Fitting instructions for the safety valve

The safety valve must be tightened with a torque of 10 Nm.

8.11. Malfunction code 'F' (flashing)

After three failed attempts in a row, the unit will lock (flashing 'F'). This can have very different causes:

- **no gas**
- **no ignition**
- **bad flame formation**
- **bad ionisation current**

8.11.1. Gas control will not open (no voltage)

Careful !!! 210 VDC

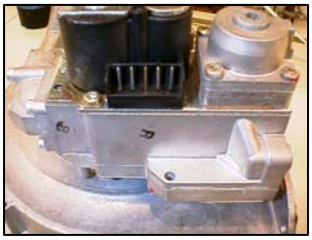
If the gas control is not connected, the Manager will see this at the beginning of the heat demand as a malfunction and therefore lock.
To measure the voltage on the gas control, the gas control must remain connected.
During the starting period, the gas control is connected to a voltage of 210 VDC.

8.11.2. Gas control will not open (gas inlet pressure too high)

The gas pressure in the gas pipe before the gas control is too high. The safety valves of the gas control cannot open with gas pressures of >60 mbar.

- open the inlet pressure measurement nipple of the gas control
- connect the pressure meter
- measure the gas pressure (10 - 50 mbar)

8.11.3. Gas control will not open (coils defective)



The electrical coils of the gas control are burnt out and the safety valves of the gas control will therefore not open.

- The two outermost contacts on the gas valve should be measured for resistance
- the value that the multimeter shows should be about 4.1 kOhm at ambient temperature.

8.11.4. Gas/air mixture is not correctly adjusted

see Chapter 4. : Adjustment full load and low load.

8.11.5. Check glow plug

The 230 volt glow plug is in order if the measured resistance at room temperature is about 1.0 - 1.4 kOhm.

- remove the connection of the glow plug (230 V)
- connect a multimeter
- measure the resistance

Replacing the glow plug

Careful !!! 230 VAC

The glow plug is a resistance through which current is fed. As a result of the high temperature of the glow plug, the burner can be ignited. This makes the glow plug a part that wears. The average life of the glow plug is estimated at 8 years, depending on the number of starts and on the variation of the mains voltage.

- remove plug from glow plug (230 V high voltage)
- remove glow plug from cover of unit
- replace glow plug

8.11.6. Check ionisation current

When the unit burns on chimney sweeper function, the ionisation current can be read directly on the display.

- Ionisation current in full load is correct between 6 µA DC to 13 µA DC.
- Ionisation current in low load is right 3µA DC to 13 µA DC.

Insulating layer

With high temperature flame, an insulating layer can be formed on the probe. This layer can be simply removed with fine sandpaper. However, coarse grooves in the surface of the pin will accelerate new formation of the layer.

8.11.7. Inspection / cleaning / replacement of the ionisation probe

- unplug the plug of the ionisation probe (low voltage).
- remove the two screws from the ionisation clamp.
- remove the ionisation probe from the lid of the unit.
- check the ionisation probe.
- the ionisation probe must be straight and clean (a slight deposit is normal).
- clean or replace the ionisation probe.

8.11.8. Ionisation probe or ionisation cable makes short circuit with earth

The negatively charged ions created by the burner form the ionisation current to earth. if there is short circuit to earth, the Manager cannot measure any current.
Repair short circuit.

8.11.9. Boiler pump

The boiler pump transports the system water through the primary heat exchanger for heating the system.

If the temperature difference between flow and return is greater than 30°C, the pump switches to a **high speed**. When the temperature difference drops below 10°C again, the pump switches back to a **low speed.**

CERTIFICATE

Number **E 1170**

CE 0063

GASTEC Certification B.V. hereby declares that the **condensing boilers**, types

80C, 40C, 30K, 30B, 30C, 15B, 15C

made by **Coopra Advanced Heating Technologies b.v,**

in **Dordrecht, The Netherlands,**

meet the essential requirements as described in the **Directive on appliances burning gaseous fuels (90/396/EEC),** and in the **Directive on efficiency requirements (92/42/EEC).**

PIN : 0063AT3070
Report number : 171070
Appliance type : B_{23}, $C_{13(X)}$, $C_{33(X)}$, $C_{43(X)}$, C_{53}, $C_{63(X)}$ $C_{83(X)}$

For corresponding appliances of marketeers, see MATRIX Black Labels.

Categories : I_{2L}, I_{2H}, I_{2E}, $I_{2(S)B}$, I_{2ELL}, I_{3P}, $I_{3B/P}$, I_{3B}

Mentioned product will be marketed

AL	(Albania)	DK	(Denmark)	IS	(Iceland)	PL	(Poland)
AT	(Austria)	EE	(Estonia)	IT	(Italy)	PT	(Portugal)
BA	(Bosnia–Herzegovina)	ES	(Spain)	LT	(Lithuania)	RO	(Romania)
BE	(Belgium)	FI	(Finland)	LU	(Luxembourg)	SE	(Sweden)
BG	(Bulgaria)	FR	(France)	LV	(Latvia)	SI	(Slovenia)
BY	(Belarus)	GB	(United Kingdom)	MD	(Moldova)	SK	(Slovakia)
CH	(Switzerland)	GR	(Greece)	MK	(Macedonia)	TR	(Turkey)
CY	(Cyprus)	HR	(Croatia)	MT	(Malta)	UA	(Ukraine)
CZ	(Czech Republic)	HU	(Hungary)	NL	(The Netherlands)	YU	(Yugoslavia)
DE	(Germany)	IE	(Ireland)	NO	(Norway)		

Apeldoorn,

GASTEC

Ir. M.L.D. van Rij,
General manager.

GASTEC Certification B.V.
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Wilmersdorf 50
7327 AC Apeldoorn

RvC

05/165

Take the time to read this document carefully before installing or using the unit. Always keep this document near the unit.

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